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A Giant Honey Bee from the Middle Miocene of Japan (Hymenoptera: Apidae)

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ABSTRACT

A new fossil honey bee is described and figured from middle Miocene deposits of Iki Island, Japan. ***Apis lithohermaea*** n.sp., is the largest fossil honey bee discovered, rivaling in size the modern giant honey bee, *A. dorsata* Fabricius. *Apis lithohermaea* is the first fossil of the *dorsata* species group recorded. Although the *dorsata* group does not occur farther north than Tibet and southern China and in the Philippines in the Pacific, this lineage occurred near what is today southern Korea and Japan during the Miocene. The geological history of the honey bees is briefly discussed in light of this new discovery. Important notes on the taxonomy of some honey bees (*A. henshawi* Cockerell, *A. aquitaniensis* de Rilly, and subspecies within *A. mellifera* Linnaeus and *A. cerana* Fabricius) are appended.

INTRODUCTION

The honey bees (genus *Apis* Linnaeus, 1758) are perhaps the most recognizable of all insects. Together with a few others animals (e.g., *Homo sapiens* Linnaeus, *Drosophila melanogaster* Meigen, *Caenorhabditis elegans* [Maupas]), the common honey bee has become one of the most heavily studied of taxa in the animal kingdom. Despite this intense scrutiny, our understanding of honey bee systematics and evolution is remarkably confused and obscured. *Apis* is the only genus in the corbiculate bee tribe Apini (Engel, 1999; Michener, 2000), although some past authors have elevated the subgenera *Megapis*, *Micrapis*, and *Synapis* to generic rank (e.g., Ashmead, 1904; Maa, 1953; Wu and Kuang, 1986, 1987). Species of the corbiculate tribes are more frequently encountered as fossils than any other lineage of bees, particularly when the common Dominican amber species, *Proplebeia dominicana* (Wille and Chandler), is included in such a survey. Even if *P. dominicana* is excluded, however, the corbiculate apines presently outnumber other bee tribes in the fossil record. This preponderance is perhaps partly owing to the eusocial behavior of these species, with typically large colony sizes. Accordingly, the fossil record of these lineages is better understood than most other bee taxa. Despite this relative clarity, the geological history of Apini is obscured owing to the paucity of critical material from the Oligocene and Miocene of Asia, the region and period of time from which honey bees presumably originated and initially radiated, as well as the complete absence of data from the Pliocene.

Herein I present the description of a new Miocene species of honey bee from eastern Asia. The specimen described below originates from the middle Miocene Chôjabaru Formation of Iki Island, Japan. The fossil is not only significant because of its geographical location and age but also in that it is a representative of the giant honey bees and is quite similar to modern *Apis dorsata* Fabricius. Indeed, this is the first fossil record for crown-group *Apis* outside of relatively modern records of *A. mellifera* Linnaeus in Pleistocene copal (Foord, 1890; Cockerell, 1909; Engel, personal obs.) and Quaternary remains of honey bee combs (Stauffer, 1979). Morphological terminology for the description follows that of Engel (2001b).

Owing to the low specific diversity of the genus and the relative homogeneity among honey bee species, the recognition of subgenera in *Apis* should perhaps be abandoned, including the Recent subgenera, as has been advocated by some authors (e.g., Michener, 2000). I have, therefore, not formally placed the fossil as to subgenus, but for convenience have indicated in the diagnosis to which group it would belong in such a system (table 1). It should be noted that in the diagnoses presented for the subgenera of *Apis* (Engel, 1999) the shape of the third submarginal cell was mistakenly presented as "angle of posteroapical margin of *first* submarginal cell less than 45°". In each diagnosis these should have read "angle of posteroapical margin of *third* submarginal cell less than 45°" (the standard wing metrics for *Apis* have been thoroughly explained by Ruttner [1988], Alexander [1991], and other authors). This correction should be kept in mind when attempting to identify honey bee subgenera and supraspecific clades (*vide etiam* Engel, 2001c).

TABLE 1
Classification of Tribe Apini[a]

Genus *Apis* Linnaeus
†*henshawi* species group
(=†*Synapis* Cockerell, †*Priorapis* Engel)
†*A. henshawi* Cockerell
†*A.* "*longtibia*" Zhang
†*A. miocenica* Hong
†*A. petrefacta* (Říha)
†*A.* "Miocene 1"
†*A. vetusta* Engel
†*armbrusteri* species group
(=†*Cascapis* Engel)
†*A. armbrusteri* Zeuner
florea species group
(=*Micrapis* Ashmead)
A. andreniformis Smith
A. florea Fabricius
dorsata species group
(=*Megapis* Ashmead)
A. dorsata Fabricius
†*A. lithohermaea* Engel, n.sp.
mellifera species group
(=*Apis* Linnaeus s.str.)
mellifera subgroup
A. mellifera Linnaeus
cerana subgroup (=*Sigmatapis* Maa)
A. cerana Fabricius
A. koschevnikovi Enderlein
A. nigrocincta Smith

[a] Because of the dubious status of *A. melisuga* Zeuner and Manning and *A. aquitaniensis* de Rilly, these species are not included (vide Engel, 1999, and appendix 1).

SYSTEMATIC PALEONTOLOGY

Apis lithohermaea, new species
Figures 1–3

DIAGNOSIS: This species is a member of the *dorsata* species group (= subgenus *Megapis*: table 1) as evidenced by its large size. The fossil can be immediately separated from the other fossil groups by the more distal position of the basal vein from cu-a (confluent or nearly so in the *henshawi* group) and by the posteroapical angle of the third submarginal cell being slightly less than 45° (greater than 45° in the *henshawi* and *armbrusteri* groups). Thus, this fossil is the first to be discovered that belongs to a clade consisting of the modern honey bee species (Engel, 1998, 1999). Among species of this clade only *A. dorsata* is characterized by the apomorphic development of an enlarged body size, elongate metabasitarsus, and infuscated wing membranes. From *A. dorsata* the new species can be differentiated by the slightly smaller size, absence of a veinal stub at the apex of the marginal cell, broader anterior border of the second submarginal cell, narrower border between the second submarginal cell and the first medial cell, more elongate second medial cell, narrower anterior border of the third submarginal cell, broader metabasitarsus, and smaller number of postauricular pectens on the inner surface of the metabasitarsus.

DESCRIPTION: **Female** (worker caste): Total body length 18 mm; forewing length 11.3 mm (preserved portion; perhaps 12 mm in life). Integument of head, mesosoma, and legs dark reddish brown; metasoma reddish brown, slightly lighter in color on first and second metasomal segments. Forewing membrane infuscated; veins light brown except C, Sc + R, and pterostigma dark reddish brown; minute, stub of an appendiculate vein at marginal cell apex absent (typically present in *A. dorsata*); anterior border of second submarginal cell longer than r-rs, nearly as long as anterior border of third submarginal cell (the anterior border of the second submarginal cell in *A. dorsata* is greatly shortened, about as long as r-rs and approximately one-quarter the length of the anterior border of the third submarginal cell); second abscissa Rs originating beyond midpoint of anterior border of first medial cell, i.e., border between second submarginal cell and first medial cell short (in *A. dorsata* the second abscissa originates near the midpoint such than the border between the second submarginal cell and first medial cell is longer); anterior border of the third submarginal cell about as long as its posterior border (in *A. dorsata* the anterior border is slightly longer than the posterior border); venation depicted in figure 3. Mesosoma slightly narrower than metasoma. Mesotibia with lateral fringe of dark setae. Metabasitarsus about as long as metatibia, about as broad as apical width of metatibia, metabasitarsus not tapering in width at apex (i.e., lateral margins not converging toward apex as is typical in *A. dorsata*), with eight or nine postauricular pectens (a.k.a., scopal

Figs. 1–2. Photomicrographs of ***Apis lithohermaea*** n.sp., holotype. **1.** Part. **2.** Counterpart.

rows, bristle rows, or pollen brush rows) (*A. dorsata*, with its longer metabasitarsus, has 12–14 postauricular pectens; this species is intriguing in that it combines a relatively elongate metabasitarsus with the plesiomorphic condition of fewer pectens; 8–9 pectens is the usual condition for species of the *mellifera* and *florea* groups). Metasomal segments typical for bees of the *dorsata* group in observable characters (e.g., proportions of segments).

HOLOTYPE: Part (fig. 1) and counterpart (fig. 2) deposited in the National Science Museum, Tokyo (NSM-P1–7418). Labeled "Holotype, *Apis lithohermaea* Engel". This material was briefly mentioned by Fujiyama (1970: 69).

OCCURRENCE: Chôjabaru Formation (middle Miocene: Langhian?), Iki Island, Nagasaki Prefecture, Kyushu Region, Japan. Insects occur in soft diatomite between amygdular basalts and volcanic conglomerates that constitute the Chôjabaru Formation. The Formation is overlain by Pliocene to Pleistocene alkali olivine basalts.

PRESERVATION: Overall the preservation is less than spectacular and many interesting characters cannot be observed. However, enough fragmentary detail can be extracted to provide a relatively robust idea as to the identity and relationships of the species. The bee is dorsoventrally compressed with the head thrust to the side with the mandibles open and the antennae missing. The mandible can be easily distinguished projecting from the apex of the head. Only one set of wings can be distinguished, the forewing extending from the body at an acute angle and alongside the metasoma. The hind wing is faintly visible and impressed beneath the forewing. On the same side of the body a foreleg is preserved extending at an orthogonal angle from the body. Fragments of a hind leg (posterior surface exposed) are preserved along the opposing side of the metasoma and posterior portion of the pterothor-

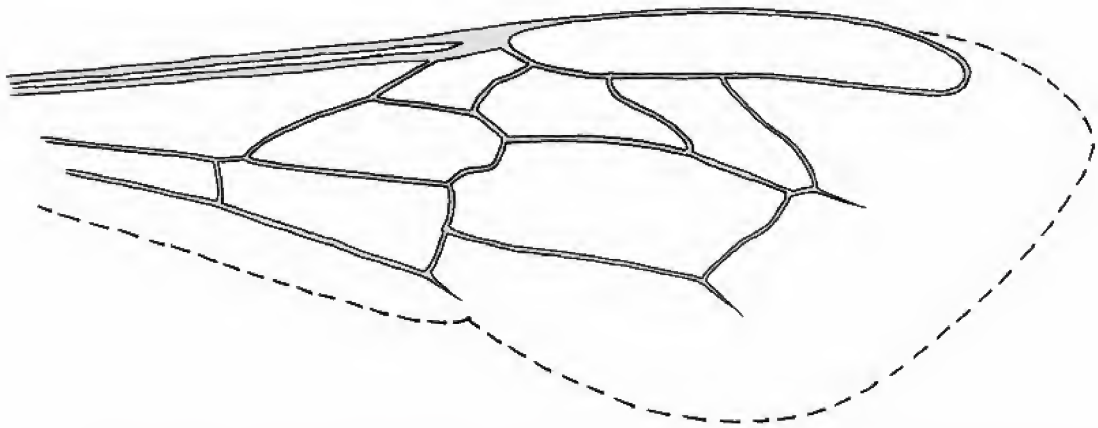

Fig. 3. Forewing venation of ***Apis lithohermaea*** n.sp. Pattern of membrane infuscation not depicted.

ax. Along with these leg podites are various plant fragments. The sting, mostly retracted, can be discerned at the apex of the metasoma.

ETYMOLOGY: The specific epithet is a combination of the Greek words *lithos* (meaning "stone") and *Hermes* (mythical messenger of the gods) and means "stone messenger".

COMMENTS: The occurrence of an open-nesting honey bee in the middle Miocene of Iki Island is in accord with reconstruction of a warm climate (perhaps warm temperate or even subtropical) for the region at that time.

DISCUSSION

Honey bees are ubiquitous animals today, being important in both agricultural and natural ecosystems. The tribe consists of distinctive bees that perhaps arose and first diversified in the Early Oligocene, after the Eocene–Oligocene climatic transitions (fig. 4). Certainly the lineage that gave rise to *Apis* had been around for millennia prior to this, as evidenced by the presence of numerous corbiculate bees allied to Apini in the Eocene (Meliponini alone is known from as far back as the Maastrichtian; Michener and Grimaldi, 1988; Engel, 2000, 2001b). However, stem-group Apini have not yet been discovered and bees with the synapomorphies we use to circumscribe the group first appear in the Late Oligocene. Interestingly, the middle Eocene Baltic amber fauna contains a group of taxa, placed in the extinct tribe Electrapini, which may represent a stem-group lineage relative to the living tribes Apini and Meliponini (Engel, 2001b). This group contains a mix of *Bombus*- or *Apis*-like bees (the genus *Thaumastobombus* in particular resembles primitive *Apis* species). The Baltic amber fossil figured by Poinar (2003) and attributed to *Apis* is a misidentification (the figure very clearly shows a nice specimen of an electrapine). It is perhaps from among taxa similar to the electrapines, which are unknown after the Eocene, that the honey bees as we understand them arose.

As previously discussed, definitive *Apis* likely originated in the Early Oligocene and radiated throughout Eurasia at that time. The distribution of the group at this time was perhaps limited by temperature extremes since species were presumably all open-nesting (i.e., building exposed combs; cavity-enclosed combs are an apomorphic feature of the *mellifera* group; Engel and Schultz, 1997; Engel, 1998). The clade of living species perhaps originated in the uppermost Oligocene or lowermost Miocene (revised from the Late Miocene hypothesis of Engel, 1998, 1999, based on the current fossil) (fig. 4). The development of cavity-nesting behavior in the latest Miocene or earliest Pliocene enabled this lineage to invade more cool temperate areas (e.g., Europe and northern Asia). Competition among species perhaps led to relatively monospecific honey bee cultures in

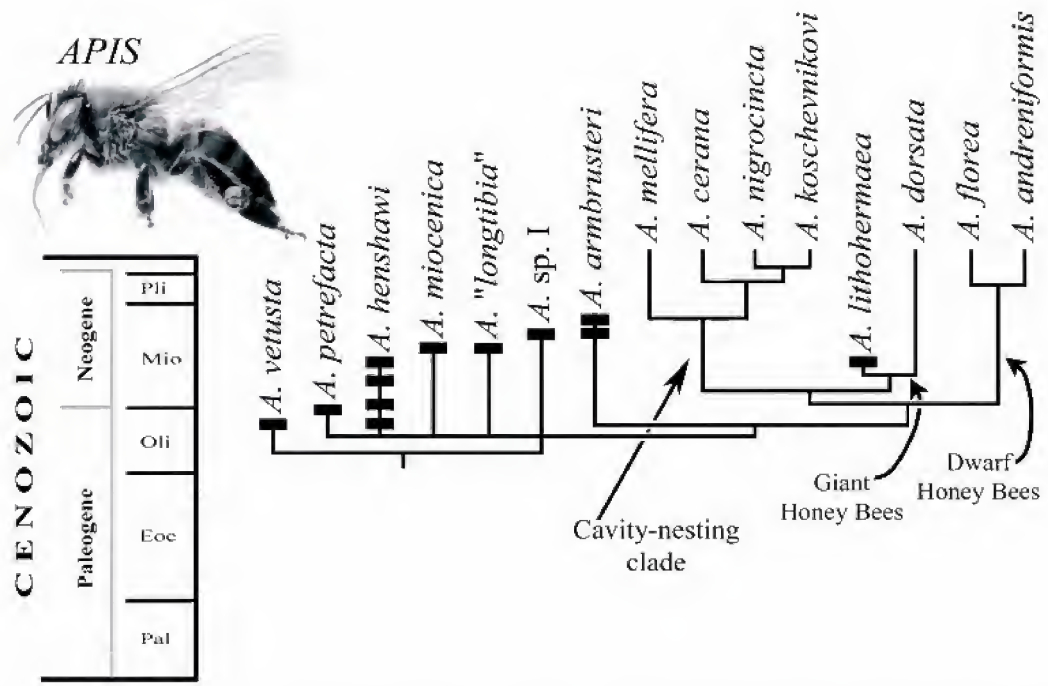

Fig. 4. Phylogeny of the genus *Apis* (vide Engel and Schultz, 1997; Engel, 1998, 1999) with the position of ***Apis lithohermaea*** n.sp., and other major fossils (black bars) indicated. The genus is represented by a habitus of *A. mellifera* L. *Apis longtibia* Zhang is very likely a synonym of *A. miocenica* Hong (and hence the name is used in quotation marks); *A. petrefacta* (Říha) may similarly be a synonym of *A. henshawi* but such a placement is less evident and therefore the name has not been placed inside quotation marks. For an explanation of "Miocene 1" refer to text footnote 3.

any given area and resulted in a low, modern specific diversity.

Contrary to my earlier assertion (Engel, 1998), specific diversity in *Apis* may have indeed slightly declined over geological time as originally suggested by Culliney (1983) (table 1; fig. 4). At present, such a decline is barely evident, but assuming that we have scarcely begun to sample the past diversity of *Apis* from Asia (most fossils come from Europe), then additional fossil taxa will undoubtedly be discovered there. Thus, *Apis* of the past would become more diverse than the genus at present (presently the number of species are nearly equal). If such a pattern of declining diversity can eventually be further supported by new paleontological discoveries, then such a decline is similar to that which has been noted generally among the highly eusocial corbiculate bee tribes (Engel, 2001a, 2001b). Aggressive competition in honey bees may have contributed to a decline in specific diversity over geological time. Certainly advanced eusocial species such as *A. mellifera* are known to influence the foraging patterns, abundance, and fecundity of other species (e.g., birds and other bees, particularly other eusocial bees) through competition for resources (Eickwort and Ginsberg, 1980; Paton, 1993; Buchmann, 1996; Sugden et al., 1996; Paini and Roberts, 2005). Indeed, *A. mellifera* workers are aggressive enough to steal pollen directly from foragers of native bee species—so-called cleptolecty (Thorp and Briggs, 1980; Jean, 2005). In fact, introduced populations of *A. mellifera* have been observed to aggressively displace native populations of *A. cerana* (e.g., Sakagami, 1959). Intensely competitive interactions among honey bee species over expanses of geological time is possibly one factor that, in combination with factors such as global climate change, may have altered *Apis* diversity.

Nel et al. (1999)[2] have presented excellent documentation of wing variation in what appears to be the common Oligocene–Miocene European species *A. henshawi* Cockerell (*A. aquisextana* Nel et al. and *A. aquisextusensis* Nel et al. are both synonyms of *A. henshawi*; Engel, 1999; vide appendix 1) and the Miocene species *A. armbrusteri* Zeuner. From their article one would be impressed by a drastic decline in honey bee species since the Oligocene–Miocene. These authors have, however, followed the morphometric system of Ruttner (1988) and thereby arrived at several "species" denoted with letters as "A–J".[3] As has been thoroughly demonstrated by the work of Hepburn and Radloff (1998) and Hepburn et al. (1998) for honey bees in Africa, such morphometric measures of wing venation do not characterize natural entities, and clustering systems based on other characters produce entirely incongruent groups of subspecies or species. Thus, morphometric clusters in *Apis* generally do not correlate with other morphological attributes, mitochondrial DNA haplotypes (Moritz et al., 1994, 1998), or general biological attributes such as presence versus absence of thelytokous parthenogenesis or ovariole number (Hepburn and Crewe, 1991). The recognition of taxa, specific or subspecific, in *Apis* based solely upon morphometric clusters of wing venation is highly suspect (summarized in Hepburn and Radloff, 1998; Hepburn et al., 1998; Hepburn, 2000). Indeed, the use of highly variable characters (e.g., drone flight times, metasomal banding coloration) for recognition of honey bee species in the absence of fixed, diagnostic apomorphic traits (or diagnostic combination of apomorphies) is not recommended. Remarkably, only a few traits of wing venation appear to be truly diagnostic for species-group taxa in *Apis*.

The recognition of species in living *Apis* is rife with difficulties, making paleontological studies all the more challenging for this group of bees. Honey bees exhibit dramatic ranges of variation over huge geographical distributions, and peripheral isolation may be the primary mechanism of speciation in the genus (thereby leaving large paraphyletic, ancestral populations difficult to characterize

[2] In 1999 (Engel, 1999) I had noted that Nel et al.'s (1999) assertion that no phylogenetic hypotheses had been produced incorporating fossils was erroneous. Indeed, Buttel-Reepen (1906) and Statz (1931) had produced early phylogenetic analyses of *Apis* incorporating fossils, and even Pongrácz's (1931) rather anagenetic assertion as to the evolutionary development of *A. mellifera* from *A. oligocenica* Meunier is a hypothesis of descent (i.e., a phylogeny of that lineage). Prokop and Nel (2003) enigmatically rejected my claim on the grounds that those hypotheses of relationship were prior to the advent of cladistics (a.k.a., phylogenetic systematics) and were, therefore, not phylogenetic. This is, of course, an absurd notion. Cladistics or phylogenetic systematics is a method of analysis to arrive at a hypothesis of relationships but has no claim to being the sole means of producing phylogenetic hypotheses (although it is assuredly the most rigorous and robust). Phylogenetic hypotheses can be arrived at using sundry methods and *any* statement purporting to unite two or more taxa can be considered a phylogenetic hypothesis, and any discussion of traits distributed across that topology or used to argue for a topology (whether "evolutionary", "phenetic", or "cladistic") may be considered an "analysis". Indeed, hundreds of workers prior to the advent of cladistic methodology produced phylogenies for all manner of organisms based on various criteria and methodologies; some were more or less defensible, but they were phylogenetic analyses and hypotheses nonetheless (e.g., Haeckel, 1866; Handlirsch, 1908; Crampton, 1924, 1928, 1938; Lorenz, 1941; Michener, 1944). Indeed, although some of these authors merely proposed phylogenetic hypotheses in words, many (if not most) explicitly depicted their hypotheses of relationship as trees and, quite correctly, termed them "phylogenies", "Stammbäume", or the equivalent. Similarly, polytomies are as much a part of phylogenetic analysis as anything else and may represent actual, historical events (e.g., the end product of centrifugal speciation or peripheral isolation models predict a polytomy). Simply because a hypothesis was produced prior to the codification of cladistics (phylogenetic systematics) does not nullify it as a hypothesis nor as a "phylogeny". Similarly, polytomies as part of a hypothesis, whether complete or partial, do not disqualify the analysis from being phylogenetic. Thus, my original statement from 1999 was correct, contrary to the erroneous opinion of Prokop and Nel (op. cit.).

[3] Although "species" A, B, and C are apparently *A. henshawi* and D, E, F, and H are apparently *A. armbrusteri*, G and I likely belong to a distinct species here referred to as "Miocene 1" (fig. 4 and table 1), noteworthy for the peculiar shape of the third submarginal cell and infuscation of the leading margin of the forewing, among other traits (E could also belong here, but the figures look more like preservational artifacts rather than diagnostic characteristics). "Species" J similarly appears to be a distinct taxon, but is more dubious, as it could be *A. armbrusteri* if the distal abscissa of M in the hind wing is erroneously recorded as absent or is merely difficult to see in the available material. The material of G, I, and J should be restudied and some of the anomalous venations in the line drawings examined for deformations by preservation.

relative to peripheral derivatives). A picture of relatively recent honey bee history (e.g., affects of Pleistocene climatic and oceanic changes) is coming into focus simply through the study of present-day populations. A more ancient perspective will certainly reveal a rich and complicated evolutionary history. Further paleomelittological work will be required, particularly in southern Asia, to further resolve the origin, radiation, and possible post-Miocene decline (if any) of the honey bees.

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APPENDIX 1

Nomenclatorial Notes in *Apis*

The following account provides nomenclatorial updates to my earlier catalog of *Apis* taxonomy (Engel, 1999, 2003). Particularly pertinent is the revised nomenclature for *A. henshawi*, but I have also appended the status of *A. aquitaniensis* as well as one subspecific epithet in *A. mellifera* and three names for subspecies in *A. cerana* that have recently appeared in the literature and that require comment. It may soon be prudent to provide an actual monograph of *Apis*, the notes for which I have already compiled.

†*Apis henshawi* Cockerell

Apis (*Synapis*) *henshawi* Cockerell, 1907: 229.
Apis dormitans Cockerell, 1907: 228. *Nomen praeoccupatum* (*nec* Heyden, 1862).
Apis oligocenica Meunier, 1915: 210.
Synapis dormitans (Cockerell); Statz, 1931: 45.
Synapis henshawi (Cockerell); Statz, 1931: 45.
Synapis kaschkei Statz, 1931: 50.
Apis cuenoti Théobald, 1937: 401.
Apis oligocaenica Goetze, 1964: 9. *Lapsus calami.*
Apis henschawi Goetze, 1964: 9. *Lapsus calami.*
Apis kaschki Goetze, 1964: 9. *Lapsus calami.*
Apis henshawi dormiens Zeuner and Manning, 1976: 241. *Nomen novum pro Apis dormitans* Cockerell, 1907.
Apis henshawi kaschkei (Statz); Zeuner and Manning, 1976: 243.
Apis aquisextana Nel, Martínez-Delclòs, Arillo, and Peñalver *In* Arillo et al., 1996: 60.
Apis aquisextusensis Nel, Martínez-Delclòs, Arillo, and Peñalver, 1999: 253. **New synonymy.**

Comments: The name *aquisextusensis* was unnecessarily proposed in 1999 (Nel et al., 1999) for a species proposed three years earlier by the same authors and based on the same material (Arillo et al., 1996). The specimens upon which the species *A. aquisextusensis* was based were first mentioned by Arillo et al. (1996), and at that time referred to as *A. aquisextana*. Since Arillo et al. (1996) provided a type designation and diagnosis for *A. aquisextana* the name became validated in that article (ICZN, 1999). Later, in a treatment of fossil honey bees, this species was recognized as a junior synonym of the more widely distributed Oli-

go–Miocene species *A. henshawi* (Engel, 1998). Confusingly, while reviewing fossil honey bees from Europe, the same authors who proposed *A. aquisextana* proposed a second name for specimens of the same type series (Nel et al., 1999). In their second contribution, however, these authors designated a different specimen as the holotype and employed the name *A. aquisextusensis* (Nel et al., 1999). Since a name had already been proposed based on the same material, *A. aquisextusensis* immediately became a junior synonym of *A. aquisextana* (and thereby indirectly of *A. henshawi*). Owing to this confusion, I herein provide a revised taxonomic summary for *A. henshawi* and officially propose the required synonymy of *A. aquisextusensis*.

†*Apis aquitaniensis* de Rilly

"Abeille Aquitanienne" de Rilly, 1924: 309.
Apis aquitaniensis de Rilly, 1949: 125.

COMMENTS: Rilly first mentioned this fossil in a brief article in an apicultural serial (Rilly, 1924) but simply referred to the species with a vernacular. The first proposal of a Latinized epithet for the same fossil appeared a quarter of a century later (Rilly, 1949). Rilly's figures and "descriptive" comments are poor and do not permit authoritative identification. His material is reported to have been deposited in the Museum de Marseille (Roussy, 1937). Repeated letters to directors and curators of this institution, however, have failed to invoke any response. From the little available evidence it is likely that this is a synonym of *A. henshawi*. Until the holotype can be located and examined, it is retained as a separate species but of uncertain taxonomic status.

Apis mellifera woyigambella Amssalu et al., *nomen nudum*

Apis mellifera woyi-gambella Amssalu, Nuru, Radloff, and Hepburn, 2004: 79. *Nomen nudum.*
Apis mellifera woyi-gambell Amssalu, Nuru, Radloff, and Hepburn, 2004: 71. *Lapsus calami.*

COMMENTS: This subspecific epithet is plagued by any number of troubles. Firstly, the ICZN (1999) explicitly prohibits the use of hyphenation or other marks (e.g., umlauts, diereses, diacritics) and the name must be emended to a single word. More troubling, however, is that the name as proposed is not available in zoological nomenclature. The subspecies was not provided with a description in words purported to differentiate the taxon, and no holotype (or type series of any kind!) was designated, as expressly required by the ICZN (1999) for the purpose of nomenclatural stability. The name must be considered a *nomen nudum* and may not be used. In general, however, I believe subspecies within *Apis* should all be synonymized under their respective species and I have, therefore, not attempted to validate a name for this form herein. If ever validated, then this name will take its authorship and date from any such later publication in cases of competing priority.

Apis cerana hainanensis Hepburn et al., *nomen nudum*

Apis cerana hainanensis Hepburn, Smith, Radloff, and Otis, 2001: 6. *Nomen nudum.*

COMMENTS: Hepburn et al. (2001) unnecessarily introduced, into an already voluminous and confusing taxonomic literature, two additional names for forms of the widely distributed Eastern honey bee, *Apis cerana* (*vide etiam* "*abaensis*" under *A. cerana heimifeng*, *infra*). Both names are *nomina nuda* under the current ICZN rules (ICZN, 1999) and therefore are not available for usage as epithets. The name "*abaensis*" was proposed for a form that had already been validated under another name (*heimifeng*). The name *A. cerana hainanensis*, however, was a novel introduction for a variety on Hainan Island that had not previously been given a Latinized name. Thus, in order to retain this form as a valid subspecies it must be proposed anew. In general, however, subspecies within *Apis* should all be synonymized under their respective species and I have, therefore, not attempted to validate a name for this form herein. If ever validated, then this name will take its authorship and date from any later publication in cases of competing priority.

Apis cerana heimifeng Engel

Apis cerana heimifeng Engel, 1999: 179.
Apis cerana abaensis Hepburn, Radloff, Smith, and Otis, 2001: 6. *Nomen nudum.*

COMMENTS: Peng et al. (1989) performed a preliminary morphometric study of variation in the Asian honey bee, *A. cerana*. From these studies they recognized several distinctive morphoclusters that they termed races and to which they gave vernacular names (for purposes of discussion). One race was identified with the vernacular name "Aba race" and later validated as *A. cerana heimifeng*. Peng et al. (1989) never employed their name "Aba" as a Latinized taxonomic entity. Recently, Hepburn et al. (2001) have unfortunately turned this vernacular name into a Latinized epithet by employing it as a subspecific name for which it was never intended, rather than use an

already valid taxonomic name for this morphotype.

Apis cerana skorikovi Engel

Apis cerana skorikovi Maa, 1944: 4. *Nomen nudum.*
Apis cerana, Himalaya race, Ruttner, 1988: 121, 158.
Apis cerana, Xizang race, Peng et al., 1989: 15.
Apis cerana himalaya Smith, 1991: 154. *Nomen nudum.*
Apis cerana himalayana Ruttner, 1992: 296; Hepburn et al., 2001: 6. *Nomen nudum.*
Apis cerana skorikovi Engel, 1999: 180.

COMMENTS: Although the names *himalaya* and *himalayana* (the latter overlooked in my 1999 treatment) as Latinized epithets are *nomina nuda* and therefore unavailable, it has not stopped them from being used frequently in the literature (e.g., Hepburn et al., 2001). A validly proposed name is available for this race, i.e., *A. cerana skorikovi*, and should be used to the exclusion of other subspecific epithets.

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